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Can Guest Worker Schemes Reduce Illegal Migration?*

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Abstract

We analyze recent efforts at international cooperation to limit illegal migration, particularly through the use of legal migration avenues like guest worker (GW) schemes. We show that while GW schemes may be desirable in themselves as an avenue of international migration, they are an inefficient instrument to induce cooperation on illegal migration. On the one hand, GW schemes suffer from a negative selection problem relative to illegal migration, which tends to erode their attractiveness to source countries. On the other hand, GW schemes increase total (legal and illegal) migration which make them a costly compensating device for the host country. Moreover, GW schemes create additional pressure on host countries to implement tough laws against illegal immigration even when the host finds such laws per se undesirable. Thus, less favorable treatment of illegal immigrants, as in California Proposition 187, may be an inevitable rather than incidental outcome of reliance on guest worker schemes. In contrast, countries that are willing to use transfers and other forms of economic assistance to induce source countries to cooperate can afford relatively liberal treatment of illegal immigrants.

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"*It is time for an immigration policy that permits temporary guest workers to fill jobs Americans will not take, that rejects amnesty, that tells us who is entering and leaving our country, and that closes the border to drug dealers and terrorists.*" – President George W. Bush, State of the Union Address, February 2, 2005.

Introduction

Few issues concern policy-makers in industrial countries more today than the problem of illegal migration. President George W. Bush's recent call for a new immigration policy reflects a widespread belief that the current immigration system is broken. In the United States alone, the population of illegal immigrants is estimated to be currently around 11 million, and every year another 500,000 or so illegal immigrants arrive.[1] The problem and the President's proposal are not new, nor is the problem specific to the U.S. What is new is the realization that combating illegal migration will be difficult and even impossible without the effective cooperation of source countries. The feasibility of such cooperation, and how source countries can be induced to participate in combating illegal migration, is the subject of this paper.

[1] Sidney Weintraub, Financial Times, April 17th, 2005.

Several partnership agreements on illegal migration between host and source countries have been concluded or are being considered. For example, exchange of information on migrant smuggling is promoted by means of technical cooperation agreements between Japan and Korea, Japan and China, Hong-Kong, China and the US, the EU and some of its neighbors. Readmission agreements are being used to facilitate the return of illegal immigrants back to their countries of origin or transit, and are elements of the dialogue between a cluster of South Caucasus and Western European countries (OECD, 1999; page 74). Highlighting the importance of such agreements, a report by the Council of Europe (1997) noted that "*the return of illegal migrants can be made effective only through the full co-operation of the authorities of the country of origin and, as appropriate, of those of the transit countries.*" The report goes on to recommend that "*readmission clauses, relating to both nationals and third country citizens, be inserted in general co-operation agreements with countries which are sources of irregular migration, such as agreements relating to economic or political co-operation.*"[2]

The Binational Study on Migration (1997) conducted jointly by the U.S. and Mexico has also emphasized the need for a joint effort by the two countries to resolve the problem of illegal migration. There is already evidence suggesting that Mexico can play an important role in this respect. For example, the government of the Mexican state Baja California Norte has taken the initiative of designating *zonas de exclusion* (off-limit areas) at especially treacherous border areas and stationed agents to prevent illegal crossings. Although these measures are limited in scope, they have significantly boosted United States' efforts at securing part of its

[2] Chinese officials have also accepted US demands to pursue smugglers more aggressively and to impose severe punishment on illegal immigrants (Djajic, 2001, page 150).

border with Mexico. Leiken (2002) notes that "*were Mexico to share responsibility for border safety, the Southwest border strategy would have a real chance of success. Mexico would have to implement all along the border the policy currently applied by the state of Baja California Norte and take the further step of actually detaining those who repeatedly enter off-limits zones.*"

A key issue is how source countries can be induced to participate in such efforts. In this paper, we consider two possibilities. Firstly, source countries could be compensated for their effort by direct monetary transfers or concessions in other areas as has been recommended by the Council of Europe. The second option is an expanded guest-worker (GW) scheme to compensate source countries, which seems to be the option under consideration in the U.S.-Mexico case. For example, Rosenblum (2005, p. 6) argues that "*a new guest worker program should be structured as bilateral between the United States and Mexico*" and in exchange for a new guest worker (GW) treaty the U.S. should demand "*a substantially expanded Mexican role in discouraging undocumented emigration.*" In the sections that follow we analyze the potential use of GW schemes, derive implications for the structure of cooperation and contrast the results with those obtained when transfers are used.

GW schemes can, of course, directly lead to a decline in illegal migration by offering at least some of those who would have migrated illegally an avenue for legal migration. But our results reveal that the use of GW schemes to compensate source countries for their cooperation is fraught with problems, and such a policy is not the first-best compared to, for example, monetary transfers. The second best nature of such schemes is closely related to the preference structure of source and host countries. First of all, except in the unlikely

circumstances where legal migration can be perfectly targeted, legal migration increases total (legal and illegal) migration which makes it a costly compensating device for a host country that is averse to further immigration.[3] Secondly, from the source country perspective, GW schemes suffer from a *negative selection* problem compared to illegal migration, in that such schemes are likely to attract those for whom the cost of migrating is relatively high. (This phenomenon is merely the flip side of the *positive selection* in illegal migration which attracts those who have low migration costs and therefore less to lose from making multiple illegal attempts.) This aspect of GW schemes erodes their relative attractiveness for source countries. Sustaining mutually beneficial cooperation through GW schemes is therefore difficult and more costly than through direct transfers from host to source.

We also find that under plausible conditions, cooperation through guest worker schemes creates a stronger incentive for the host to implement tough laws against illegal immigrants than cooperation through transfers or no cooperation at all. In the absence of cooperation, the host determines optimal treatment of illegal immigrants, balancing the benefits of deterring illegal immigration against the social costs of implementing harsh and discriminatory policies. With cooperation, the incentive to implement tough laws increases because they provide the additional benefit of reducing the compensation that the host needs to make to the source. Since GW schemes have a higher social cost than transfers, there is an even stronger incentive to economize on this form of compensation by toughening laws.

These results have implications for policy. While GW schemes may be desirable in themselves as an avenue of international migration, they are an inefficient instrument to in-

[3] As Sidney Weintraub notes, "The belief that a large guest worker programme would eliminate the need for border surveillance is fiction; the allowed number of such workers would never be enough to accommodate all who wished to emigrate." (Financial Times; April 17th, 2005)

duce cooperation on illegal migration. International cooperation on illegal migration is more effectively sustained through direct transfers from host to source countries. Such transfers have the additional virtue of creating less pressure on host countries than GW schemes to implement laws that treat illegal immigrants less favorably.

The existing literature on illegal migration has paid little attention to the issues mentioned above. By and large the focus has been on unilateral actions taken by host countries to combat illegal immigration rather than on international cooperation. Ethier (1986a, 1986b) pioneered the new model of illegal immigration by analyzing the effect of border and internal enforcement schemes implemented by the host country. Bond and Chen (1987) extended the Ethier model to examine the impact of interior inspections by the host country's government on the welfare of the host country when capital is internationally immobile, while Yoshida (2000) analyzed the case when capital is internationally mobile. Myers and Papageorgiou (2000) derived the optimal level of border enforcement from the host country's point of view when illegal immigrants can and cannot be excluded from costly public services. Bandopadhyay and Bandopadhyay (1998) focused on the impact of employer sanctions by the host on the welfare of the source country while Gayton-Fergoso and Lahiri (2000) considered the effect of foreign aid on illegal immigration. The present paper differs from all these studies by focusing squarely on cooperation between countries to regulate illegal migration.

The paper is structured as follows. In section 1 we outline the basic structure of the model. In section 2 we derive the non-cooperative solution to the game. International cooperation with transfers is discussed in section 3. Section 4 deals with cooperation without transfers. We summarize our results and suggest scope for future work in the conclusion of

the paper.

Section 1

1.1 *Basic structure*

Consider a game with two countries called source (s) and host (h). Total population in each country is normalized to unity. There is a single aggregate good in the world produced with labor alone. Each agent in h, s produces w_h, w_s units of the good, respectively. w_h, w_s are treated as parameters of the model and interpreted as the wage rates with $\lambda \equiv w_h - w_s$ as the wage differential.

As in the broader literature on illegal migration, border enforcement measures play an important role in our model too. The key point in our model is that the host cannot acting alone prevent illegal migration beyond a certain level, and that cooperation by source countries can help relax this constraint. We capture this feature in the simplest possible way by using a variant of the "costless border enforcement" model analyzed, for example, in Myers and Papageorgiou.[4] Let $p \in [0, 1)$ denote the probability that an agent is caught while attempting to cross the border illegally. The host can costlessly implement any p value in the interval $[0, \bar{p}]$ where $\bar{p} < 1$ is exogenously given and may depend on factors such as the geographical proximity of the two countries, and the size of network effects, etc.

[4] We also used a border enforcement model where the cost to host of patrolling the border rises with p and found the main effects remain the same.

Cooperation by the source country involves a fixed cost of $E_s^* \geq 0$ to source and it relaxes the upper bound on p from $\bar{p}$ to p^* where $1 > p^* > \bar{p}$.[5]

Next we introduce the cost of migration. We assume that each time an agent attempts to cross the border, successfully or not, he incurs a cost C where C is uniformly distributed over $[0, 1]$ across the source country populace.[6] As we show later, this structure of migration cost implies that the cost of legal and illegal border crossing differs because the former involves only one attempt while the latter involves multiple attempts. We discuss this point in more detail and provide some supporting evidence in section 2. Having crossed the border, an illegal alien may face other costs (because of his illegal status) which we will denote by $\eta \geq 0$. Examples of such *internal costs* include: difficulty in inviting family members, exploitation by employers, denial of basic labor rights, and limited access to public services and goods as for example in recent U.S. laws like California Proposition 187, Personal Responsibility and Work Opportunity Reconciliation Act as well as the Illegal Immigration Reform and Immigrant Responsibility Act. These internal costs, at least to some extent, are determined by the policy of the host country and will be treated as an endogenous policy variable. A higher η value reflects higher internal cost arising from tougher laws against illegal immigrants present in the host country.

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[5] There is some evidence to suggest that it may be difficult to push p beyond a certain limit at least in the short run. For example, the General Accounting Office in its 2001 report noted that the border patrol had been unable to meet the Southwest strategy personnel demand because of its concern that the ratio of inexperienced-to-experienced agents was getting too high (Leiken 2002, pp. 11-12).

[6] It does not matter for our results whether heterogeneity arises in the cost (economic and non-economic) or the differences in the earning potential (wage differential) of the migrants. What matters is the net expected benefit from migration. This can be seen by noting that C and λ enter symmetrically in the net benefit from migration.

1.2: *The host country problem*

Illegal immigration poses a number of problems to the host country which, in the context of this paper, can be broadly classified into two groups. Firstly, illegal immigration may be a problem simply because it leads to excessive or *unwanted* immigration. Secondly, *illegality* per se may pose additional problems to the host. Immigration may be unwanted because it leads to unemployment in the host country (Ethier 1986, Winter-Ebmer and Zweimüller 1998), sectoral or regional displacement of natives (Hatton and Tani 2003), politically unfavorable factor price movements (Ethier 1986a,b), fiscal pressure (Myers and Papageorgiou 2000)[7] , sociocultural and linguistic differences which may adversely affect local cultures and life-styles (Bliss 1994, Schiff 1992).[8] These adverse effects from immigration are not due to the illegality of migration but simply because of excessive immigration. Thus, these costs are common to legal and illegal aliens and are referred to as the "social cost" from legal migration.

The additional cost of illegality most obviously relates to the greater likelihood of crime and the increased threat to national security. The cost of illegality to the host may depend on its policies towards illegal aliens. For example the denial of access to medical services can create a health hazard, denial of access to the formal labor market can push immigrants into the underground economy, and exclusion from labor unions can lead to social tensions.[9]

[7] Also see, for example, Lee and Miller 2000, Auerbach and Oreopolis 2000, Storesletten 2000 and Borjas 1999.

[8] Other studies which analyze the impact of immigration on local culture include Putnam 1995, Carlton 1995, Coleman 1987, 1988, 1990, Knack and Keefer 1997, etc.

[9] For example, Costich (2001-02) argues that measures such as the Personal Responsibility and Work Opportunity Reconciliation Act and the Illegal Immigration Reform & Immigrant Responsibility Act which were implemented in 1996 and severely limited health care access to undocumented immigrants in the U.S., are likely to have adverse health consequences for all U.S. residents.

Furthermore, the discriminatory treatment of illegal immigrants through tough laws (high η value) can reduce native welfare for humanitarian reasons. These examples suggest that the social cost from illegal migration is greater than that from legal migration and it is increasing in η. However, the opposite case is also possible. For example, illegal immigrants do not bring their families and dependents with them implying a lower fiscal burden on the host country, are willing to take jobs which the natives and legal immigrants do not want, work below minimum wages yielding a larger surplus to the native employers, and impose a smaller fiscal burden on the host country when they do not have full access to public services and goods. While the full range of possibilities presents a rich case, we will focus on the former, more relevant possibility.

Let $S_L(S_I)$ denote the social cost from legal (illegal) immigration which is the loss in the aggregate welfare of the natives of the host country from each legal (illegal) immigrant. We assume that S_L is an exogenously given parameter but $S_I'(\eta) \equiv dS_I/d\eta \geq 0$ and $S_I(\eta) \geq S_L$. That is, the social cost of illegality is increasing in η. By definition, the pure cost of illegality to host is equal to $S_I - S_L$.

Section 2: Unilateral policies

In this section we analyze the case when the two countries set their policies unilaterally. The game proceeds as follows. In the first stage (the government of) the host country decides to implement a value of $\eta \in [0, \eta_1]$. With this in place we proceed to stage 2 where the host

implements p, L where L is the number of legal immigrants invited by the host (size of the GW scheme). Simultaneously, the source chooses $E_s \in \{0, E_s^*\}$[10] . Note that the choice of η is irreversible in stage 2. The motivation for this is that while border enforcement measures and GW schemes can be adjusted in the short run, policy decisions on the rights of illegal immigrants are based on deeply-rooted beliefs and typically require a lengthy political process.[11] The solution below is obtained by backward induction.

2.1: *Illegal migration function*

Treat η as given and consider the second stage of the game. Since migration must be privately beneficial, all agents with $C < \lambda$ will apply for the GW scheme. We assume that agents are selected randomly for the scheme. That is, the selection is independent of an agents' intention to migrate illegally or not if he were not selected.[12] Next, agents who are not selected for the GW scheme decide whether to migrate illegally or not. Computing the expected net benefit from migrating illegally relative to staying home, we get that all agents not selected for GW scheme and with $C < \tilde{\lambda}(1-p)$ will migrate illegally where $\tilde{\lambda} \equiv \lambda - \eta$.[13]

[10] The choice of E_s is simply the source country's decision to unilaterally control illegal migration by investing E_s^* or do nothing ($E_s = 0$).

[11] Part of the reason for this may be that such measures are viewed by many in host countries as unfair and a reward for violating the national law while for others it is a humanitarian issue. With such sharp differences amongst natives, it may take long to implement changes in either direction. Johnson (1998) lends some support to this idea when analyzing the possibility of ending discrimination and exploitation of Mexicans in the U.S. he states that: "Unfortunately, significant evidence suggests that it would not be [possible], at least under the present political, economic and social conditions."

[12] The assumption is natural since it is unlikely that the government in either country will have complete information on an agent's migration cost, although it may know the overall distribution of C. It is possible that the source country may be able to screen agents by their cost. We abstract from this unlikely possibility.

[13] Interpretation of the previous inequality is as follows: if an agent decides to migrate then with probability $1-p$ he will be successful in crossing the border in which case he will earn $w_h - \eta$; further, with probability p he will be caught in which case he returns home and earns w_s. In either case he incurs a cost of C. He will attempt migrating illegally if and only if the expected benefit from doing so is higher than the benefit from

Solving for the level of illegal migration we get that it is equal to

$$I = I(p, L) \equiv I(p, 0)[1 - L/\lambda] \quad ..... \quad (1)^{14}$$

$$I(p, 0) = \tilde{\lambda}(1 - p) \qquad ..... \quad (2)$$

Assumption 1: $0 < \lambda < 1$. The assumption is necessary and sufficient for migration to be strictly interior when $p = \eta = 0$ and we treat it as a regular interior solution condition.[15]

2.2 *Welfare and GW schemes*

Let W_s, W_h denote the welfare of the source and host country, respectively. We have

$$W_s = w_s + \lambda L/2 + \tilde{\lambda} I/2 - E_s$$

Interpretation of the expression for W_s is as follows. For any given L, all agents with $C \in [0, \lambda]$ apply for legal migration. Since agents are randomly selected for the GW scheme, the migration cost of the average legal migrant equals $\lambda/2$ and his surplus (net benefit) is also equal to $\lambda/2$. This explains the coefficient of L. Now consider illegal migrants. These

staying home. That is, $(1 - p)(w_h - \eta) - C + pw_s > w_s$.

[14] As in the broader literature on illegal migration we have assumed that an agent who is caught at the border can attempt to migrate illegally again and again. Consequently there is no distinction in our model in the number of people who attempt illegal migration and those who succeed in doing so. The only factor relevant is the number of attempts it takes to cross the border successfully. This equals $I/1 - p$. There is some anecdotal evidence to support the assumption. For example, Espenshade (1994) argues that greater border enforcement results in migrants making multiple attempts at crossing the border before they finally succeed in evading the border patrol. Along similar lines, Hanson et. al. (2001, p.44) note that: "Each time a migrant is caught, he or she is detained and sent back across the border, usually within a few days. This allows the migrant to make two or more attempts at illegal entry within a period as short as a week."

[15] The assumption is necessary and sufficient for at least some people to migrate but not all when $p = \eta = 0$ (free migration case). The qualitative nature of our results is unaffected by the assumption.

are all agents with $C \leq \tilde{\lambda}(1-p)$ and who are not selected for legal migration. The total migration cost of a typical illegal migrant is equal to $C(1-p)^{-1}$ in expected value where expected value is taken over the number of attempts he makes to cross the border. Thus, the total migration cost of the *average* illegal migrant is equal to $\tilde{\lambda}/2$ and his surplus is also equal to $\tilde{\lambda}/2$. This explains the coefficient of I in W_s.[16]

It is important to note here that the surpluses of the average legal and illegal migrant are different only due to a positive η value. This may seem surprising at first but is actually quite simple. Since illegal migration involves more than one attempt, the benefit from it is lower than from legal migration for any given agent. However, since illegal migration is more costly due to multiple attempts, only the relatively low-cost agents attempt it (*positive selection*). In other words, the C value of the average illegal migrant is $\tilde{\lambda}(1-p)/2$ while the C value for the average legal migrant is higher and equal to $\lambda/2$. This makes illegal migration more desirable than legal migration to the source country. Putting these two competing effects together we find that they cancel out so that the benefit from legal and illegal migration differs only because of a positive η value. The positive selection in illegal migration can be equivalently interpreted as a negative selection in legal migration. We will use both these interpretations.

The importance of the selection process for source and host countries has been noted in the literature although not in the precise sense analyzed in this paper. For example, Chiswick (2000) notes that:

[16] Some care is needed in interpreting W_s in terms of L, I as derived above. The reason for this is that I is not a direct policy parameter: countries choose, L,p and η which determines I. Therefore, for any given L, η value a unit increase in I implies that p changes appropriately to effect the change in I under consideration. The same argument applies to changes in I arising from a change in L or/and η.

"Among countries for whom entry restrictions are binding, the criteria for rationing immigration visas (demand) will influence the favorable selectivity of those who actually migrate." Continuing further he states: "Whether migrants are favorably selected or not is important for understanding the economic and sociological consequences of migration for the sending (origin) and receiving (destination) regions, as well as for the migrants themselves. .... As a consequence, the extent of favorable selectivity of migrants will effect the immigration policies of the destination and emigration policies of the origin. Immigration history, and as a result, the histories of the origin and destination regions are thereby influenced by the selectivity of migrants."

The result that legal and illegal migration are *perfect* substitutes in the source country's welfare function when $\eta = 0$ is specific to the structure of our model. However, the basic result, a positive selection in illegal migration, is sufficiently general and the qualitative nature of our results will be preserved in other model specifications.[17]

We summarize some of the results above as follows.

[17] In more general settings than ours, the source country's preferences over total migration and the composition of migration will depend on the distribution of C and other factors which determine the net benefit from legal over illegal migration. It is not obvious how the cost of illegal and legal migration differ partly because the impact of border enforcement on illegal migration is difficult to observe (Hanson et. al., 2001). However, there is strong evidence favoring our main idea that higher border enforcement implies that a larger number of attempts are needed for a successful border crossing. For example, Hanson and Spilimbergo (1999) find that a 10% increase in border enforcement leads to an 8% to 10% increase in border apprehensions along the U.S.-Mexico border. There is also some evidence that an illegal immigrant may choose to cross the border at remote locations such as in the Arizona desert to improve the likelihood of successful entry (Cornelius, 2000). In our model we have ruled out this possibility for the simple reason that while these routes imply a higher C for an illegal migrant than a legal one, however, the probability of getting caught is also lower. Hence, it is not clear how the total cost of illegal migration varies over remote and more traditional routes.

Result 1: If all agents have an equal chance of being selected for a GW scheme, then such schemes involve negative selection, in that high-cost agents who would not migrate illegally get selected for legal migration. The benefit to source from substituting illegal with legal migration is therefore significantly eroded. In our simple linear model, the potential benefit is completely eliminated iff $\eta = 0$ leaving the source indifferent to the composition of migration.

The impact of GW scheme for host countries is as follows. From equation (1) it is evident that total migration, $I + L$, is strictly increasing in L except when there is a free-border and no internal sanctions ($p = 0, \eta = 0$). Formally, for any given p, $dI/dL = -\tilde{\lambda}(1-p)/\lambda$ which is less than one in absolute value. Thus, if L rises by 1 unit then total migration will rise by $1 - \tilde{\lambda}(1-p)/\lambda > 0$ for all $p > 0$. For brevity, call this the *leakage effect*. Intuitively, while the GW scheme has no effect on the incentives of those who would have migrated illegally anyway, it allows some agents to migrate legally who would not have emigrated illegally because of their high C value.[18] We summarize the finding as follows.

Result 2: Total migration (legal plus illegal) rises with the size of a GW scheme because such schemes induce the migration of high-cost agents who would otherwise not have migrated. Host countries that are primarily interested in controlling total migration, and are not concerned about its composition, will be made worse off by such schemes if they are implemented unilaterally.

[18] That is, all agents selected for the GW scheme with $\lambda > C > \tilde{\lambda}(1-p)$.

2.3 *Nash equilibrium policies*

The unilaterally optimal policy of the source country is to set $E_s = 0$ since this avoids the cost of E_s^* and ensures minimum p given host's strategy. Note that $\partial W_s/\partial p = -\tilde{\lambda}^2(\lambda - L)/2\lambda < 0$. With $E_s = 0$, we have

$$W_h = w_h - S_L L - S_I I$$

The expression for W_h shows that immigration (legal or illegal) is always detrimental to host's welfare. This result is due to the simple structure of our model where gain in consumer surplus to natives from immigration has been ruled out for three reasons. Firstly, it simplifies the algebra considerably and allows us to draw sharp results. Secondly, the qualitative nature of results is unaffected because on pure economic grounds (gain in consumer surplus) the host and source are indifferent between legal and illegal migration.[19] Thirdly, the assumption enables us to focus on the situation where there is excessive immigration from the host perspective and GW schemes are used purely to facilitate cooperation on illegal migration, which is the central concern of this paper.[20]

Differentiating we get $\partial W_h/\partial p = \tilde{\lambda} S_I(\lambda - L)/\lambda$, $\partial W_h/\partial L = \tilde{\lambda} S_I(1-p)/\lambda - S_L$, and $\partial W_s/\partial L = \lambda/2 - \tilde{\lambda}^2(1-p)/2\lambda > 0$.[21] The Nash equilibrium values of p, L lie at a corner.

[19] That is, a change in the status (legal vs. illegal) of an immigrant affects host's welfare due to the difference between S_I, S_L and the source's welfare due to the difference in the migration cost ad the wage differential between legal and illegal migrants. After controlling for these effects in our model we are left with the output produced. Since a mere change in the status has no effect on output and hence consumer surplus, host's preference between legal and illegal immigration is unaffected by the inclusion of consumer surplus in the model. The same applies to the source.

[20] In a companion paper we allow for beneficial effects of immigration through increased consumer surplus to natives and show that the desirability of legal over illegal migration to host and source is still driven by the same factors as highlighted in this paper.

[21] The previous two inequalities are strict at interior values.

There are three possible corner solutions which are stated in Appendix A2. Throughout the paper we will focus on one such solution given by:

$$p = \bar{p}, L = 0 \text{ if and only if } \frac{\lambda S_L}{1-\bar{p}} > \tilde{\lambda} S_I > 0$$

Interpretation of the Nash equilibrium is as follows. The host ideally prefers no legal or illegal migration. If the capacity limit, $\bar{p}$, is sufficiently close to one then, irrespective of η, the optimal policy of the host is to set $L = 0$ and $p = \bar{p}$. This provides us with a useful result in that any use of legal migration in the Nash equilibrium must then be due to the difficulty in sealing the border sufficiently well. It is also simple to see from the solution that there are benefits and costs to the host in using legal migration. The benefit is that to the extent legal migration substitutes illegal migration, total social cost decreases (when $S_L < S_I$). The cost is that legal migration is not a perfect substitute for illegal migration due to the leakage effect, so that total migration rises with L which pushes host's welfare downwards. It is straightforward to verify from the full solution in Appendix A2 that if the leakage effect were absent or sufficiently small (small $\bar{p}, \eta$ values) then the unique Nash equilibrium would feature full legal migration and no illegal migration.[22]

Assumption 2: In the remainder of the paper we assume that the condition stated in the solution above is satisfied so that $p = \bar{p}$ and $L = 0$ in the Nash equilibrium.

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[22] That is, as $\bar{p} \to 0$ and $\eta \to 0$, then $d(I + L)/dL \to 0$. From Appendix A2 we can see that this implies that $L \to \lambda$. Intuitively, if there is no leakage effect then a unit increase in L will reduce I by one unit. Host's welfare will consequently rise with $S_I > S_L$.

2.4 *Optimal η value*

The impact on host's welfare from a change in η can be decomposed into two parts: the direct impact when the Nash equilibrium values of p, L stated above do not change, and the indirect impact when the solution shifts from one corner to another. Throughout the paper we will focus on the former only by appropriate choice of restrictions on the parameters.[23] The motivation for doing so is that in more general settings than ours where the solution is interior, changes in solution values with respect to η will have only a second order effect on W_h while the first order effects will come from the direct changes that we analyze in the paper.

Host's marginal benefit from η with p, L set optimally at their Nash equilibrium levels is given by:

$$dW_h/d\eta = (1-\bar{p})S_I - (1-\bar{p})\tilde{\lambda}S_I'(\eta)$$

The first term on the right-hand-side (RHS) of the equation captures the benefit to host from lower illegal migration when η rises. The second term captures the cost to the host due to the movement in S_I and is evaluated at the original migration level. Throughout the paper we will assume that $d^2S_I/d\eta^2 > 0$ and is sufficiently large so that the second order maximization condition over η is globally satisfied.[24] Let η^N denote the Nash equilibrium value of η.[25]

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[23] See Assumption 2 below for the appropriate restrictions.

[24] A sufficient condition for this is that $2S_I'(1-\bar{p}) - \tilde{\lambda}(1-\bar{p})d^2S_I/d\eta^2 < 0$ for all η. Assume that this holds in the remainder of the paper.

[25] Under the assumptions stated in the paragraph η^N is well defined and unique.

Section 3: Cooperation with transfers

The scope for cooperation depends on the structure of externalities across countries from unilateral actions and the set of policy instruments open to negotiations. Throughout we will assume that negotiations occur over p, L (with and without transfers) but η is not negotiated. The assumption broadly reflects the experience that the rights of illegal aliens are not formally negotiated with source countries. Further, it allows us to focus squarely on what can and cannot be achieved using GW schemes alone.

3.1 *International externalities and cooperation*

There are two types of international externalities. The source country's decision to do nothing in the Nash equilibrium lowers host's welfare by keeping p low. If this were the only externality, then global welfare would be enhanced by source country's participation and a higher value of p provided that the fixed cost of E_s^* is not too high. However, host's actions also have a negative effect on the source country. Higher p and lower L reduce W_s implying that a more liberal migration regime (lower p and higher L) would enhance global welfare. While both these possible types of externality exist, we assume in this paper that the former dominates. Necessary and sufficient conditions for this case are stated below.[26]

In this section we analyze the scope for cooperation when lump sum transfers can be made internationally (the *transfer regime*). We assume throughout the remaining paper

[26] In a companion paper we discuss the more general case where the dominant externality could be either of the two mentioned above.

that the host has complete bargaining power.[27] The cooperative game is as follows. In the first stage the host announces η value which is fixed thereafter. In the second stage countries negotiate and implement an agreement over L, p, T and E_s where T is the transfer from the host to source.[28]

With transfers available, the cooperative outcome maximizes the joint welfare of the two countries and transfers are used to keep the source country's welfare at its Nash equilibrium level which equals $W_s^N(\eta^N) = w_s + \tilde{\lambda}^2(1-\bar{p})/2$. Because of the linear structure of the model, there are four possible cooperative outcomes depending upon the underlying parameter values: (i) free illegal migration, i.e. $p = 0$, $L = 0$, $E_s = 0$; (ii) free legal migration, i.e. $p = 0$, $L = \lambda$, $E_s = 0$; (iii) Nash equilibrium with $p = \bar{p}$, $L = E_s = 0$; and (iv) full enforcement, i.e. $p = p^*$, $L = 0$ and $E_s = E_s^*$ which is our proposed solution.

The full enforcement equilibrium (iv), in which the source country participates in border enforcement, is globally efficient if and only if it yields higher global welfare than the outcomes in (i)-(iii) above. Comparing (iv) with (i) to (iii) gives us the following conditions:

$$E_s^* < (S_I - \tilde{\lambda}/2)\tilde{\lambda}p^* \quad .... \quad C1$$

$$E_s^* < \tilde{\lambda}(1-p^*)(\tilde{\lambda}/2 - S_I) - \lambda(\lambda/2 - S_L) \quad .... \quad C2$$

$$E_s^* < \tilde{\lambda}(p^* - \bar{p})(S_I - \tilde{\lambda}/2) \quad .... \quad C3$$

Interpretation of conditions $C1 - C3$ is as follows. $C1$ rules out the possibility that global welfare is higher in a borderless world ($p = 0, L = 0$) relative to the proposed cooperative

[27] The assumption simplifies the algebra and allows us to distinguish our results from the ones in the literature where an agent (host in our model) with less than full bargaining power can benefit from a strategic move (adjusting η value) made prior to the bargaining game.

[28] When T is negative it would imply a transfer from source to host.

case ($p = p^*$,$L = 0$). In short, "free illegal migration" is ruled out. The restriction is mild given that our focus is on cooperation in reducing illegal migration.[29] Similarly $C3$ is necessary and sufficient for global welfare to be higher at the proposed cooperative solution than at the Nash equilibrium. Intuitively, this means that the cost of increasing p through the source country's participation is globally affordable.

The substantive condition is $C2$ under which global welfare is higher in the proposed cooperative case than with free legal migration. This condition means that the aggregate impact of legal migration on global welfare outweighs the cost savings from eliminating border enforcement. Hence, given $C1, C3$, under $C2$ transfers are strictly preferred to an expanded GW scheme as a means of compensating the source, and the latter is at most a second best instrument for fostering international cooperation.[30]

Whether $C2$ holds will depend on the direct effect of legal migration on global welfare, as well as its indirect effect on welfare through the induced change in illegal migration The selection process and the leakage effect outlined above influence the magnitude of both these effects. Thus the negative selection in legal migration implies a lower value of $\lambda/2 - S_L$, the global net surplus from a unit increase in legal migration. And the positive selection in illegal migration implies a higher value of $\tilde{\lambda}/2 - S_I$, the global net surplus from a unit increase in illegal migration. Both these effects make $C2$ more likely to hold than otherwise. Since

[29] With Assumption 2 holding, a cooperative outcome with free illegal migration would require transfers from source to host ($T < 0$) which are rarely observed in the real world. Hence we believe that ruling out this possibility does not involve much loss of generality. In a companion paper we discuss the possibility of free illegal migration as an equilibrium outcome in more detail.

[30] We note here that $C2$ also rules out the cooperative outcome where the source bribes the host through transfers for more legal migration. Motivation for ruling out this case has been already discussed above. Thus, $C2$ not only ensures that GW is not used as a compensating device in the cooperative effort but also ensures that selling legal migration in return for transfers is not optimal.

illegal migration is globally undesirable (by $C1$), the leakage effect makes the use of legal migration less attractive in the cooperative process. Specifically, the coefficient of $\tilde{\lambda}/2 - S_I$ in $C2$ captures the leakage effect and the larger the effect the more likely that $C2$ holds. Summarizing the discussion above, we get the following Result.

Result 3: Under Assumptions 1,2 and conditions $C1 - C3$, transfers are the first best policy instrument for sustaining cooperation over illegal migration and are strictly preferable to GW schemes. GW schemes create additional distortions and are only a second best instrument.

Computing the welfare of the host country in the cooperative outcome with transfers we have

$$W_h^T(\eta) \equiv w_h - S_I\tilde{\lambda}(1-p^*) - T(\eta)$$

where $T(\eta) = E_s^* + \tilde{\lambda}^2(p^* - \bar{p})/2$ is the amount of transfer from host to source.

3.2 *Optimal η value*

There are two competing ways in which a higher η affects W_h^T: lower transfers and lower illegal immigration versus host's (dis)utility from tougher sanctions on immigrants. Formally, the marginal benefit function and the first order optimality condition for η is

$$\partial W_h^T/\partial\eta = \tilde{\lambda}(p^* - \bar{p}) + (1-p^*)[S_I(\eta) - \tilde{\lambda}S_I'(\eta)] = 0 \quad .... \ (3)^{31}$$

[31] The partial derivative indicates that p, L are held fixed at $p^*, 0$ respectively which is also optimal for the cooperative game being considered here. As above, we are assuming here that conditions $C1 - C3$ and Assumptions 1,2 are satisfied for all $\eta \in [0, \eta_1]$.

The equation differs qualitatively from $\partial W_h/\partial\eta$ due to the first term, $\tilde{\lambda}(p^* - \bar{p}) = -\partial T/\partial\eta$. Interpretation of $\partial T/\partial\eta$ is as follows. When p rises from $\bar{p}$ to p^* source country's welfare decreases by $(\tilde{\lambda}/2)[I(\bar{p},0) - I(p^*,0)]$ and the host must make a transfer of an amount equal to this loss.[32] This loss is the forgone surplus of would-be illegal aliens. An increase in η alters the size of this loss in two ways. Firstly, the surplus of the average illegal immigrant $(\tilde{\lambda}/2)$ decreases implying a smaller loss to source. Secondly, reduction in illegal migration $(I(\bar{p},0) - I(p^*,0))$ is smaller at a higher η value which again implies a smaller loss to source. On both these counts the compensatory transfer decreases. Let η^T denote the solution value of η.[33] Without much loss of generality we will assume that $\partial W_h^T/\partial\eta = 0$ at η^T.[34]

It is simple to see that $\eta^T > \eta^N$ (except at corner solutions). That is, at $\eta = \eta^N$, $\partial W_h^T/\partial\eta$ is equal to $\tilde{\lambda}(p^* - \bar{p})$ which being strictly positive implies that η will be revised upwards from its Nash equilibrium level in the transfer regime. This is simply the extra benefit to host from increasing η to reduce the transfer amount to the source country which is completely absent when there is no-cooperation.[35] We state this formally in the following Result:

Result 4: Suppose that conditions $C1-C3$ hold and the Nash equilibrium involves $p = \bar{p}$ and

[32] Also, the transfer must compensate the source for the fixed cost, E_s^*, it incurs.

[33] Assume that the W_h^T is globally concave in η with appropriate restrictions on the structure of S_I.

[34] That is, we are ruling out corner solutions with the first order condition in (3) may not hold. Note that this does not rule out corner solutions since (3) can hold at $\eta = 0$ or η_1.

[35] It is possible that η^N may be equal to η^T when the solution occurs at the corner. Also, if η^N or η^T have multiple solutions then it is impossible to compare their values as the comparison will depend on which solution values we pick. However, the general point remains that in addition to the direct effect of η on host's welfare, the incentive to lower the transfer amount provides an additional benefit from increasing η to host under cooperation with transfers relative to the Nash equilibrium case.

$L = 0$ as stated above. The benefit to host from an increase in η is higher under cooperation with transfers than in the Nash equilibrium. The reason is that higher η reduces the transfer that the host needs to make to the source, an effect that is absent when there is no-cooperation.

Section 4: Cooperation without transfers

In this section we analyze cooperation without transfers (the GW regime). This issue is important because many countries are averse to the idea of international transfer payments on ethical or budgetary grounds.

4.1 *Solution to the second stage*

For any given η, the cooperative outcome is obtained by maximizing W_h over p, L subject to the *participation constraint* (PC) that the source country's welfare is no less than the Nash equilibrium level.[36] When cooperation occurs, PC is satisfied by all L, p combinations such that:

$$L = \frac{2E_s^* + \tilde{\lambda}^2(p - \bar{p})}{\lambda - \tilde{\lambda}^2(1-p)/\lambda} \equiv L(p, \eta) \quad \text{where } p \geq \bar{p}$$

[36] For simplicity, we are assuming here and elsewhere in the paper that the host has all the bargaining power and extracts the entire surplus from cooperation. The assumption is not important for the qualitative nature of our results.

It can be checked that $L(p, \eta)$ is increasing and concave in p. The no-cooperation case in the GW regime occurs when $p = \bar{p}$, $E_s = 0$ and it satisfies the PC.

The key question we address here is whether the potential gains from cooperation can be realized using the GW scheme alone (i.e., without transfers) and how does the optimal value of η differ between the GW regime and the transfer regime. We have two main results. The first is that due to their second best nature, GW schemes are a more costly way of achieving cooperation than transfers, implying less surplus from cooperation. Further, in many situations GW schemes are completely ineffective in sustaining cooperation. Our second broad finding is that this inefficacy of GW schemes in fostering cooperation creates additional incentives for the host to implement tougher measures (η value) against illegal immigrants compared to the case with transfers. Consequently, optimal η is higher in the GW regime than in the transfer regime.

4.2: *Structure of cooperation in the GW regime*

Treating η as exogenously given we derive here the necessary and sufficient conditions under which cooperation occurs in the GW regime and the optimal value of p. We then derive the optimal value of η and compare it with the one for the transfer regime.

Maintain Assumptions 1,2 and $C1 - C3$ throughout. Let p^c denote the optimal value of p under cooperation in the GW regime. Necessary and sufficient conditions for cooperation to occur are:

$$L(\bar{p}, \eta) < \lambda$$

$$\tilde{\lambda} S_L < \lambda S_I$$

$$\tilde{\lambda} S_I (p^* - \bar{p}) < [S_L - S_I \tilde{\lambda}(1 - p^*)/\lambda] L(p^*, \eta)$$

Interpretation of these conditions is as follows. In the cooperative outcome $p^c > \bar{p}$ for otherwise the host can achieve the same value unilaterally without having to pay for E_s^*. The amount of legal migration the host has to offer to satisfy the PC equals $L(\bar{p}, \eta)$, for the fixed cost incurred by the source plus an extra amount to compensate the source for p^c above $\bar{p}$. However, the maximum possible legal migration in our model is λ. Thus, $L(\bar{p}, \eta) < \lambda$ is a necessary condition for PC to be satisfied at any $p^c > \bar{p}$. Now consider the second condition and note that it is violated iff $\eta = 0$ and $S_I = S_L$, i.e. if both the source and host are indifferent to the composition of migrants between legal and illegal. From the welfare function of the two countries, it is simple to see that no-cooperation will result here because the only way the host can benefit from cooperation is if total migration falls below its Nash equilibrium level but this would make the source worse off, violating the PC. Finally, consider the last condition. Along the PC, the host's marginal benefit function in p is: $dW_h^{GW}/dp = \tilde{\lambda}(\lambda - L)(\lambda S_I - \tilde{\lambda} S_L)/D$ where $D \equiv \lambda - \tilde{\lambda}^2(1-p)/\lambda > 0$ and $L = L(p, \eta)$. Under the first two necessary conditions stated, the marginal benefit is strictly positive for all p implying that $p^c = p^*$ and L equals $L(p^*, \eta) \equiv L^*$. To ensure that cooperation is beneficial we need the host's welfare at p^*, L^* to be strictly higher than in the Nash equilibrium, which gives us the stated condition.[37] This completes our discussion of the nature of cooperation for any given η.

4.3: *Optimal η when cooperation occurs*

[37] It can be checked that $L(p^*, \eta) < \lambda$ when the first necessary condition, $L(\bar{p}, \eta) < \lambda$, is satisfied.

Suppose that the necessary and sufficient conditions stated above hold so that cooperation occurs in the GW regime. Host's marginal benefit from η evaluated at the cooperative solution is:

$$dW_h^{GW}/d\eta = \left[\frac{-\partial W_h/\partial L}{\partial W_s/\partial L}\right]\frac{\partial(W_s^* - W_s^N)}{\partial \eta} - \left(\tilde{\lambda}(p^* - \bar{p}) - \partial W_h^T/\partial\eta\right)(1 - L^*/\lambda) \quad ... \quad (4)$$

where W_s^* is source country's welfare at p^*, L^* and W_s^N is the same in the Nash equilibrium, $\partial W_h^T/\partial\eta$ is host's marginal benefit from η in the transfer regime (equation 3), $\partial W_h/\partial L$ and $\partial W_s/\partial L$ in the square bracket are derived treating η and p fixed.

Interpretation of (4) is as follows. The last term is the direct effect (treating L, p fixed) of η on host's welfare and is the same as in section 2. We have expressed it in terms of $\partial W_h^T/\partial\eta$ for easy comparison with the transfer regime. The second term, $\partial(W_s^* - W_s^N)/\partial\eta$, is the strategic effect of η on the cooperative outcome. That is, keeping p, L fixed, a higher η lowers the source country's welfare in the Nash equilibrium (threat point) as well as its welfare at p^*, L^*. If $W_s^* - W_s^N$ falls then the host needs to make a smaller compensation measured in source's utility terms to source to ensure its cooperation. To convert this change in compensation into units of L we merely need to divide it by the marginal utility to source from L which explains the $\partial W_s/\partial L$ term in the square bracket. Lastly, to obtain the implied increase in host's welfare from this reduced L, we multiply the change in L with $-\partial W_h/\partial L$ which explains the numerator in the square bracket. We can now compare the optimal η here with the one in the transfer regime and interpret the finding in terms of the selection effect and the leakage effect discussed above.

Set $\eta = \eta^T$ in (4) so that $\partial W_h^T/\partial\eta = 0$. We have to show that the resulting expression in (4) is strictly positive, which would imply an incentive for the host to revise η above η^T.

Substituting for the various terms we can rewrite RHS in (4) as:

$$\left[\frac{S_L - S_I(1-p^*)\tilde{\lambda}/\lambda}{\lambda/2 - \tilde{\lambda}^2(1-p^*)/2\lambda}\right]\left\{\tilde{\lambda}(p^* - \bar{p}) + \tilde{\lambda}(1-p^*)L^*/\lambda\right\} - \tilde{\lambda}(p^* - \bar{p})(1 - L^*/\lambda) \quad ... \quad (5)$$

where the terms in (5) exactly match the corresponding terms on RHS of (4). For (5) to be positive, a necessary condition is that $S_L - S_I(1-p^*)\tilde{\lambda}/\lambda > 0$: i.e., the leakage effect is present and that it makes makes the host worse off from any increase in L at p^*, η^T. It can be checked that this necessary condition is implied by $C2$.[38] With the necessary condition satisfied we now check for a sufficient condition for (5) to be positive. To this end focus on the ratio in the square bracket which if greater than unity will ensure that (5) is positive (sufficient condition). The denominator in the ratio equals $\partial W_s/\partial L$ while the numerator equals $-\partial W_h/\partial L$. The negative selection in legal migration implies a lower value of the denominator term which tends to push the ratio higher.[39] A larger leakage effect (higher p^* value) has two effects on the ratio. It increases the value of the numerator as well as the denominator. The latter rises because the leakage effect makes legal migration more attractive to the source country while the former rises because the the leakage effect increases illegal migration making the host worse off. It can be checked that the overall ratio always rises with the leakage effect simply because illegal migration is globally undesirable (under $C1 - C3$): the benefit to source is less than the loss to the host from an increase in illegal

[38] See Appendix A4 for details.

[39] The selection effect has no impact on the value of the numerator.

migration. Thus, the selection effect and the leakage effect tend to push the value of the ratio upwards. It can be easily checked that condition $C2$ ensures that these effects are sufficiently strong so that the ratio is strictly greater than one. Thus, sitting at $\eta = \eta^T$, host's benefit from revising η upwards is strictly positive implying a higher optimal η in the GW regime than in the transfer regime.

4.4 *Optimal η when no-cooperation occurs*

In this part, we consider situations where no-cooperation results in the GW regime in the absence of tough laws against illegal immigrants. We show that the host then has an incentive to implement tough laws in order to induce the source to cooperate. We appropriately benchmark the model so that under the same conditions (parameter values) the host has no incentive to implement tough laws if transfers were available. While there are many situations where this result holds, we show one such situation below, highlighting the basic effects driving the outcome.

Maintain Assumptions 1,2 and conditions $C1 - C3$ so that the cooperative outcome in the transfer regime is as stated in section 3. Impose the benchmark condition so that $\eta^T = 0$. The proof involves first showing that with $\eta = \eta^T = 0$ there is no-cooperation and then showing that the host can achieve some cooperation by raising η above η^T and is thereby better off.

Now set $\eta = 0$. Maintain the necessary conditions for cooperation to occur stated above: $L(\bar{p}, 0) < \lambda$ which is equivalent to $E_s^* < E_1 \equiv \lambda^2 \bar{p}/2$ and $S_I(0) > S_L$. No-cooperation occurs iff host's welfare in the Nash equilibrium is greater than at $p^*, L(p^*, 0)$. This is equivalent

to the following condition holding:

$$[S_L - (1-p^*)S_I]\left[\lambda + \frac{2E_s^* - \lambda^2\bar{p}}{\lambda p^*}\right] \geq \lambda S_I(p^* - \bar{p})$$

RHS of the inequality is the benefit to host from lower illegal migration due to the increase in p under cooperation while the LHS is the total loss to host from the expanded GW scheme. From $C2$ we know that the first term on LHS is strictly positive implying that LHS is strictly increasing in E_s^*. It is easy to verify that the inequality is strictly violated at $E_s^* = 0$ and strictly satisfied at $E_s^* = E_1$. Thus, there is exists a critical value of E_s^* at which LHS=RHS implying that the host is indifferent between the cooperative outcome and the Nash equilibrium. Now consider the case when E_s^* is equal to this critical value. What we have now is no-cooperation in the GW regime when $\eta = \eta^T = 0$. Since all these conditions are consistent with $C1 - C3$ and Assumptions 1,2, the structure of cooperation if transfers were available is same as in section 3.

We are left to show that the host can achieve some cooperation by raising η and that doing so is optimal for it. To see this suppose that the host moves from no-cooperation and $\eta = 0$ to a cooperative outcome with $p = p^*, L = L(p^*, 0)$ first and then revises η upwards by a small amount. The change in p and L with $\eta = 0$ will have no effect on host's welfare as stated above. The marginal impact of the revision in η on host's welfare evaluated at $\eta = 0, p = p^*, L = L(p^*, 0)$ is given by:

$$\partial W_h/\partial\eta = [S_L - (1-p^*)S_I]\,|dL(.)/d\eta| + (1-p^*)[S_I - (\lambda - L)S_I']$$

where $|dL(.)/d\eta| = \dfrac{2\lambda(p^* - \bar{p}) + 2L(1-p^*)}{\lambda p^*} > 0$. The first term on RHS is the benefit to host due to a lower L needed to induce the source to cooperate when η rises and the second

term is the direct effect (i.e., for fixed L) from higher η. Imposing the benchmark condition from equation (3) for $\eta^T = 0$ we get that a sufficient condition for $\partial W_h/\partial\eta$ above to be strictly positive is that $S_L - (1-p^*)S_I > p^*\lambda/2$. It can be easily checked that this inequality is implied by $C2$. Thus, the host is able to sustain mutually beneficial cooperation by revising η above η^T and is thereby better off than with $\eta = 0$. In words, we have identified parameter values for which cooperation occurs in the transfer regime and the optimal value of η equals zero. However, due to their second best nature (condition $C2$), GW schemes are unable to sustain any cooperation without tough laws against the illegal population. The host then has an incentive to implement tough laws to achieve some cooperation making itself better off in the process. This completes the proof.

We summarize the results here in the following way.

Result 5: In a wide range of situations, no beneficial cooperation can be achieved using GW schemes and weak laws against illegal immigrants ($\eta = 0$). The host then finds it optimal to implement tough laws to sustain cooperation and thereby improve its welfare. Even in situations where GW schemes are successful in sustaining cooperation , they are a costly way of compensating the source for its effort at controlling illegal migration. The host then has an incentive to reduce this cost by implementing tough laws against illegal aliens (high η value). The incentive to use tough laws is much weaker when the more efficient tool, namely transfers, is available as a compensating device.

Conclusion

While cooperation between host and source countries to deal with illegal immigration is undeniably desirable, the choice of instruments of cooperation is critical. An aversion, for fiscal or political reasons, to the use of transfers can make limited legal migration schemes seem an attractive alternative. A number of governments are today flirting with guest worker schemes. Such schemes are likely to reduce the level of illegal migration simply because some of those who would have migrated illegally will choose instead the legal route. This substitution effect by itself is likely to be of limited use given the magnitude of illegal migration pressures. The more important consideration, therefore, is whether such schemes can induce source countries to cooperate in limiting illegal migration. This paper has identified serious problems in this regard. We have shown that legal migration channels suffer from negative selection and leakage problems which reduce their attractiveness to the source and the host, respectively. Therefore, sustaining cooperation through such channels is not first best policy in that the potential benefits from cooperation cannot be fully reaped.

It is also significant that the choice of instrument can have a bearing on the broader policy environment. In particular, the use of legal migration creates additional pressure on the host to implement tough laws against the illegal immigrants present in the country even when the host is otherwise averse to such measures. Thus, less favorable treatment of illegal immigrants, as in California Proposition 187, may be an inevitable rather than incidental outcome of reliance on guest worker schemes. In contrast, countries that are willing to use transfers and other forms of economic assistance to induce source countries to cooperate can

afford relatively liberal treatment of illegal immigrants.

We made a number of simplifying assumptions to obtain the main results. But we believe that the selection and the leakage effect are sufficiently general and would survive in richer model specifications yielding results similar to those we found. Of course, it is entirely plausible that other aspects of legal and illegal migration not captured by our simple model may alter the results. One possibility is that there are potential global benefits from legal migration which we ruled out. In a companion paper we explore this aspect in detail. Another important issue is the duration of migration, because guest worker schemes are conceived of as temporary presence schemes whereas illegal migration often leads to longer term presence. How this affects our results will depend on the dynamic effects of the two types of migration. This is a fruitful area for future work.

We have also assumed that guest worker schemes cannot target individuals. Both weaknesses of GW schemes highlighted above could be reduced and even eliminated if effective targeting were feasible, but for several reasons this seems unlikely. First, it is doubtful that governments can obtain the necessary information. In our simple model governments would need to know individuals' migration costs, but in a more general setting governments would be required to distinguish potential migrants by their contribution to the source country's national welfare. Secondly, the preferences of the source and host may diverge on migrant selection. For example, while the host may like potential illegal migrants to be drawn into the guest worker program, the source may prefer to use the program to facilitate the migration of those who would otherwise not migrate. This problem would also dampen incentives for information sharing between source and host. Finally, the host itself may need to balance

the desire to divert potential illegal migrants into the guest worker scheme against the desire to attract individuals who would contribute most to the host country's national welfare. All these considerations suggest that perfect sorting may be neither feasible nor desirable.

Illegal migration is perhaps the least understood area as far as empirical work is concerned. This paper identifies a number of issues that merit more attention. At a broad level, these issues relate to the preference structure of source and host countries over legal and illegal migration, the equilibrium relationship between the two forms of migration and the border enforcement technology. Firstly, a host country's preference between legal and illegal migration depends on the pure cost of illegality. There is some empirical work on factors that shape natives' preference towards illegal immigration and amnesties. However, this work has failed to distinguish between aversion to pure illegality and the social cost of legal migration (unwanted migration). Our results have shown that this distinction is important in designing optimal migration policies. Similarly, an understanding of source country's preference for legal over illegal migration is crucial in any effort to seek their participation in building an international migration policy. Secondly, there is no empirical evidence on how legal migration impacts upon the level and structure of illegal migration. Future work in the area can help understand the empirical significance of the leakage and selection effects which we have shown to be important from the policy point of view. Lastly, the border enforcement technology continues to be a black box. How source country's cooperation affects the efficacy of border enforcement measures is even less well understood. It is hoped that demonstrating the significance of these issues will promote more empirical research in this area.

Appendix A

Appendix A1: *A more general structure of migration cost*

We show that source country will have little concern for the legal/illegal composition of migration and will be concerned mostly with total migration in more general settings than ours provided that p is sufficiently small as stated in *Result 1*. Suppose that the cost of each attempt at crossing the border illegally involves a cost of pC_1 in addition to the cost C stated in the sections above. pC_1 can be interpreted in two ways. Firstly, if the agent is caught at the border then he incurs a fine of C_1 or if he is detained then the income forgone during the detention period is C_1. Since this cost is incurred only if he is caught, pC_1 is simply the expected over and above C. The second interpretation is that when p rises agents may have to pay higher coyote fees or use more remote areas for border-crossing which entails a higher cost for each attempt at crossing the border illegally. The cost of legal migration is only C. For any given L, the level of illegal migration equals $I_1 \equiv [\tilde{\lambda}(1-p) - pC_I][1 - L/\lambda]$ and the average migration cost for all illegal immigrants equals $[\tilde{\lambda}+\phi]/2$ where $\phi \equiv pC_1/(1-p)$. The welfare of the source country equals: $W_s(C_1) \equiv w_s - E_s + \tilde{\lambda}I_1/2 + \lambda L/2 - \phi I_1/2$. When $\eta = 0$, then $W_s(C_1)$ depends on the ratio of the composition of illegal/legal migration only through the last term, $\phi I_1/2$. It is trivial to see that this term is arbitrarily small at sufficiently small values of p. Thus, when border enforcement is very costly so that p is sufficiently small then the source country is largely interested in total migration $(I_1 + L)$ and have little concern for legal/illegal ratio. The main results of the paper can be therefore extended to such host/source countries.

Appendix A2: The Nash equilibrium of the game in section 2 is as follows[40] :

$$p = 0, L = 0 \text{ if and only if } \tilde{\lambda} S_I \leq \lambda S_L \text{ and } \tilde{\lambda} S_I \leq 0$$

$$p = \bar{p}, L = 0 \text{ if and only if } \frac{\lambda S_L - \alpha \bar{p}}{1 - \bar{p}} > \tilde{\lambda} S_I > 0$$

$$p = 0, L = \lambda \text{ iff } \tilde{\lambda} S_I > \lambda S_L \text{ and } \tilde{\lambda} S_I - \lambda S_L \geq \bar{p} \tilde{\lambda} S_I$$

Appendix A3: Necessary and sufficient conditions for $p = p^*, L = 0$ and $E_s = E_s^*$ to be globally efficient under cooperation with transfers for any given η are as follows:

$$E_s^* < (S_I - \tilde{\lambda}/2)\tilde{\lambda} p^* \quad .... \quad C1$$

$$E_s^* < \lambda(S_L - \lambda/2) - \tilde{\lambda}(1 - p^*)(S_I - \tilde{\lambda}/2) \quad .... \quad C2$$

$$E_s^* < \tilde{\lambda}(p^* - \bar{p})(S_I - \tilde{\lambda}/2) \quad .... \quad C3$$

Assumptions 1 and 2 in the sections above hold

Explanation of these conditions is as follows. Let $\Omega(p, L)$ denote global welfare for any given p, L, η. Cooperation with transfers implies that cooperative outcome is one which maximizes $\Omega(p, L)$. Because of the linear structure of the model there are only four possible cooperative outcomes: (i) $p = 0$, $L = 0$ in which case $E_s = 0$; (ii) $p = 0$, $L = \lambda$ in which case $E_s = 0$; (iii) Nash equilibrium with $p = \bar{p}$, $L = E_s = 0$; and (iv) $p = p^*$, $L = 0$ and $E_s = E_s^*$ which is our proposed solution.

The proposed solution is globally efficient if and only if gives a higher global welfare than the outcomes in (i)-(iii) above. Given Assumptions 1,2, conditions $C1, C2, C3$ are

[40] In deriving these conditions we made use of the tie-breaking assumption that when the host indifferent between any two or all three outcomes then: $p = L = 0$ is preferred over the other two outcomes; $p = 0, L = \lambda$ is preferred over $p = \bar{p}, L = 0$.

necessary and sufficient for our proposed solution to dominate the outcomes in (i),(ii) and (iii), respectively.

Note that $C1$ implies that a necessary condition for (iv) to dominate (i) is that $S_I > \tilde{\lambda}/2$. That is, with $L = 0$, lowering p from p^* to zero will increase global welfare if the previous inequality is violated. Interpretation of this result is that S_I is the social cost on the host from a unit increase in illegal immigrant while the loss to the host country is the wage differential net of migration cost and the cost due to positive η value which, on an average, equals $\tilde{\lambda}/2$. If the latter is larger than the former then cooperation will lead to a more liberal border policy.

Appendix A4:

From section 3 we have $C2$ at $\hat{p}$ as:

$$\lambda(S_L - \lambda/2) - \tilde{\lambda}(1-\hat{p})(S_I - \tilde{\lambda}/2) > E_s^* \geq 0$$

Rearranging we get the inequality implies that

$$S_L - (\tilde{\lambda}/\lambda)S_I(1-\hat{p}) \geq \frac{\lambda^2 - \tilde{\lambda}^2(1-\hat{p})}{2\lambda}$$

The inequality implies that $S_L - (\tilde{\lambda}/\lambda)S_I(1-\hat{p}) \geq 0$ which in turn implies that $S_L - (\tilde{\lambda}/\lambda)S_I(1-p^*) > 0$ for all $p^* > \bar{p}$. This completes the proof.

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